

Entrepreneurial Decisions and Problem-Solving: a Discussion for a New Perspective Based on Complex Thinking

Dr. Patricia Esther Alonso-Galicia

Tecnologico de Monterrey, Mexico,  <https://orcid.org/0000-0002-2076-066X>

Dr. Adriana Medina-Vidal

Tecnologico de Monterrey, Mexico,  <https://orcid.org/0000-0002-3414-4307>

Prof. Simona Grande

Università Di Torino, Italy

Abstract: This work addresses the importance of innovation in entrepreneurial and business education to ensure that students develop the ability to make complex decisions and solve complex challenges. The intention was to incorporate the complexity theory in decision-making and problem-solving in business and entrepreneurship. To achieve this, we present the results of the first phase of our project, aiming to scale the levels of complex thinking in university students, discuss the need for business and entrepreneurship students to develop complex thinking competency (including its sub-competencies of critical, systemic, scientific, and innovative thinking) in the complexity of the business environment, analyze the relevance of system elements, apply their inductive and deductive reasoning, and create appropriate and relevant solutions. Our findings suggest that an educational model focused on developing complex thinking and its four sub-competencies can enable entrepreneurs to integrate sustainable development, increase their social engagement and critical thinking, develop their imaginative intelligence and discursive and reflective skills, and thus improve their decision-making and problem-solving processes. In the future, we plan to extend this analysis to the behavior of real-life entrepreneurs.

Keywords: Educational Innovation, Higher Education, Professional Education, Complex Thinking, Entrepreneurial Decisions

Citation: Alonso-Galicia, P. E., Medina-Vidal, A. & Grande, S. (2023). Entrepreneurial Decisions and Problem-Solving: a Discussion for a New Perspective Based on Complex Thinking. In M. Koc, O. T. Ozturk & M. L. Ciddi (Eds.), *Proceedings of ICRES 2023 International Conference on Research in Education and Science*, (pp. 822-930), Cappadocia, Turkey. ISTES Organization.

Introduction

Society currently faces complex challenges, such as sustainability, characterized by an undefined nature,

multiple potential solutions, and unique characteristics with competing objectives and open deadlines. To effectively address these challenges, educational institutions like business schools must equip students with the competencies and skills necessary to understand and solve these issues. Literature on entrepreneurial and business education highlights the importance of critical thinking, reflective thinking, and multiple intelligences. These skills are crucial for students to make informed decisions and solve problems effectively.

In the literature on the competencies and skills relevant to entrepreneurial and business education, most authors emphasize the importance of critical thinking (Amblee et al., 2022; McDonald et al., 2022). The AACSB (2018) refers to reflective thinking, and Carreira et al. (2022) to imaginative, aesthetic, multiple intelligences, and discursive and reflective reasoning skills. The AACSB (2018:35) recommends integrating technology into decision-making and problem-solving. This includes evidence-based decision-making integrating current and emerging technologies across the curriculum, including statistical tools, data management, data analytics, and information technology. Additionally, it is recommended that students demonstrate higher-order cognitive skills to analyze an unstructured problem, formulate and develop a solution using appropriate technology, and effectively communicate the results to stakeholders. Several universities have started to innovate how they design and teach business courses to ensure students develop the ability to make complex decisions. This approach emphasizes equipping students with the skills necessary to understand and solve complex challenges such as sustainability.

Literature Review

Entrepreneurial decisions, problem-solving, and rational frameworks

Several studies have explored various methods for understanding entrepreneurs' thought processes and actions. One such method is the concept of effectuation, proposed by Sarasvathy, which stems from the understanding that entrepreneurial processes are characterized by uncertainty and risk; it postulates that opportunities are created by the actions of entrepreneurs with available resources and not from the logic of prediction or causality (Sarasvathy, 1998; Sarasvathy, 2001). Effectuation and other prescriptive methods for entrepreneurship have faced criticism. For example, Mansoori and Lackeus (2020) compared effectuation with five other methods: discovery-based planning, prescriptive entrepreneurship, entrepreneurial planning, lean startup methodology, and design thinking. The authors use a three-step methodology to perform the comparison at three hierarchical levels (logic, model, and tactics) and in nine different dimensions (uncertainty management, resource management, knowledge extension, redirection power, continuous learning, iterative process, stakeholder interaction, team collaboration, and value creation) to illustrate their strengths, weaknesses, and complementarities. One of the authors' conclusions is that entrepreneurial methods should be articulated and taught as the result of collaboration between academicians and practitioners, which could deepen students' complex thinking as they grasp that the decisions they make to solve problems must consider what works, when, for whom, and in what context.

Several scholars consider that entrepreneurial actions are based on a rational, logical framework or are preceded by impulse (Lerner et al., 2018a, 2018b; Wiklund et al., 2016, 2018). We propose incorporating the complexity theory in the discussion to support entrepreneurs in creating value. While there is debate about the rationality of entrepreneurial actions, we must understand the impulse behind such actions. Kurdoglu et al. (2022) proposed a new framework combining rational and irrational logic based on the decision-makers' motivations. They argued that a decision is deemed motivationally rational when the truth is sought and motivationally irrational when interest is sought without empirical grounding.

Furthermore, they posit that motivationally rational decisions are based on reality and aim to find solutions that align with it, while motivationally irrational decisions are detached from reality and driven by impulses. The authors' argument about the adaptive potential of irrational decisions from a motivational standpoint is innovative and noteworthy. However, their reasoning raises questions about differentiating between impulsive decision-making and a lack of knowledge organization, whether decision-making in extreme uncertainty is always wholly irrational, and whether the observer can distinguish different rational and impulsive decision-makers. Additionally, it raises the question of whether the decision-maker characterized as rational is always aware of the knowledge he possesses and reality and whether the decision-maker characterized as impulsive does not also seek to understand the facts from his particular logic.

Complex thinking as a coherent framework

Although the proposal is highly sophisticated and goes beyond the simple dichotomy between rational and irrational actions, it is also limiting because what is defined as irrational could only be a lack of conscience. From the perspective of complexity theory, the problem in decision-making is not the factual error (false perception) or the logical error (incoherence) but the way we organize our knowledge into systems of ideas (Morin 2001). Therefore, rational actions and decisions are not devoid of errors, ignorance, and blindness. Every decision results from selecting significant data and rejecting non-significant data, i.e., operations that separate, unite, hierarchize, and centralize. These operations are based on principles of thought organization that permeate our vision of things and the world, even though we are unaware of it. Thus, qualifying the selection or rejection of significant or non-significant data as rational or irrational results in a one-dimensional view.

Classifying and explaining business decision-making as rational or irrational leads to simplistic thinking. One must develop complex thinking to get away from this mutilating and one-dimensional vision. Complex thinking makes it possible to clarify the opposition between rationalization (a logical system of explanation but deprived of empirical foundations) and rationality that strives to unite coherence with experience and to grasp the need for a rationality that is both critical and self-critical (Morin, 2020:52-53). In this sense, business and entrepreneurial careers should promote the development of complex thinking for decision-making and problem-solving.

It is crucial to teach entrepreneurs to observe the information, representations, concepts, ideas, and myths in

their minds to be clear that they are mediators between their ideas and reality. Complex thinking aspires to a non-partitioned, non-divided, non-reductionist, and non-unidimensional knowledge, i.e., it leads to multidimensional thinking that seeks all that is interrelated, interacting, and interfering. At the same time, it recognizes the unfinished and incomplete nature of all knowledge (Morin, 2001). It is necessary to become aware and sensitized to the enormous shortcomings of our thinking and to grasp that a mutilating thought necessarily leads to mutilating actions. This requires a reforming of thinking that seven complementary and interdependent principles can guide: the systemic or organizational, the hologram, the retroactive circle, the recursive circle, the autonomy/dependence, the dialogic, and the reintroduction of the knower in all knowledge (Morin, 2020). To the extent that entrepreneurs develop their complex thinking, they have within their reach other strategies, another starting point to make decisions and solve problems in a less mutilating way.

Concerning complex thinking and its sub-competencies, recent research has found a significant link with developing skills among business students. For example, Kuzina et al. (2022) identified critical thinking as essential in developing skills among business students, such as reading comprehension. Thus, they concluded that strengthening critical thinking in business areas reinforces knowledge acquisition and enables individuals to work more efficiently.

Results

A methodology for complex thinking development

Our interdisciplinary research group, Reasoning for Complexity (R4C), aims to scale higher education students' mastery of complex thinking skills by implementing training systems supported by Open Science and Technology 4.0 strategies. These strategies include connectivity, digitalization, virtualization, artificial intelligence, and data science, among others, linked to projects undertaken by the quadruple helix (university-industry-government-civil sector) for sustainable development solutions (Figure 1). Our paper shows the results of the first phase of a project that aims to scale the levels of complex thinking in university students in Mexico through case study models and personalized learning, open science, and artificial intelligence, using mixed-method measurements and supporting sustainable development goals.

One of the project's first-phase results was the systematization of the principles of the theory of complex thinking by authors such as Edgar Morin to conceptualize what we define as the macro competency of complex thinking that is integrated by four sub-competencies (critical, systemic, scientific, and innovative thinking) (Baena-Rojas et al., 2022; Ramírez-Montoya et al., 2022). The macro competency of complex thinking is a cognitive tool that can expand the thinking capacity of people facing challenging situations or problems. It can also help people develop competencies that allow them to think comprehensively about reality with a broad vision of the world (Vázquez-Parra et al., 2022) (Table 1). Table 1 shows that complex thinking perceptions for university students in Mexico are more developed in Schools of Medicine and Social Sciences than in Business (Vázquez-Parra et al., 2022).

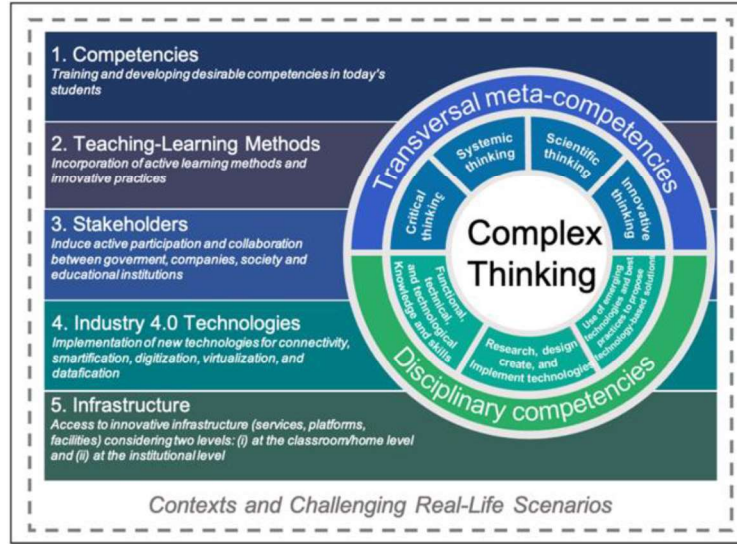


Figure 1. Complex Thinking in Education 4.0

	Medicine	Architecture	Humanities	Social Sciences	Engineering	Business
\bar{X}	4.13	3.86	3.97	4.11	3.90	3.84
σ	0.83	0.93	0.89	0.75	0.84	0.87

Source: Vázquez-Parra et al., 2022

Table 1. Disciplinary areas in Higher Education and Complex Thinking

Regarding the sub-competencies, *critical thinking* evaluates the soundness of one's own and others' reasoning to form a judgment in a situation or problem and identify false arguments; *systemic thinking* analyzes the relevance of the system elements and is determined by analyzing the existing set; *scientific thinking* encompasses a set of reasoning strategies or cognitive processes, like inductive and deductive reasoning, problem-solving, and formulating and testing hypotheses; and *innovative thinking* allows problem-solving and designing and creating solutions for social progress (Rodríguez-Abitia et al., 2022). Developing the macro competency of complex thinking and its sub-competencies has unlimited scope in any field, including business and entrepreneurship.

Validated tools and instruments (eComplexity)

Another significant result of the research group was the design of the eComplexity instrument to measure the students' perceived mastery of complex thinking and its sub-competencies. This instrument was validated theoretically and statistically by a team of experts in the field (Castillo-Martínez et al., 2022). It comprises twenty-five items (each answered on a 5-level Likert scale), grouped into the four sub-competencies. In turn, each sub-competency is divided into the areas of knowledge, skills, and attitudes or values (Vázquez-Parra et al., 2022).

So far, we have used the instrument in various university institutions in 19 different countries: Argentina, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Finland, France, Germany, Guatemala, Holland, Italy, Mexico, Nicaragua, Paraguay, Peru, Spain, United States, Dominican Republic, and Venezuela. In addition to the eComplexity instrument, our research group also generated the Profile of the Social Entrepreneur instrument to evaluate the students' perceived mastery of social entrepreneurship and relevant skills through 28 items integrating five dimensions (personal, leadership for social change, social innovation, social value, and management for social change). The latter instrument was applied during entrepreneurship and used a 5-level Likert scale (García-González et al., 2020).

For example, this instrument was applied to a sample of 328 students in a private Mexican university in Guadalajara. The results showed that students perceived themselves as competent in sub-competencies related to personal values through indicators such as communication, knowledge of others, motivation, perseverance, and persuasion. They perceived themselves with limited practical, administrative, and implementation skills (Cruz-Sandoval et al., 2022). So, these students had a high index of personal values and a low index of competencies related to their environment's economic and administrative reality.

Discussion and Conclusion

Our research group obtained several significant results, including the systematization of the principles of the theory of complex thinking, the conceptualization of macro and sub-competencies of complex thinking, and the use of instruments to measure both the perceived mastery of complex thinking and social entrepreneurship competency. These results provide a solid methodological foundation for discussing topics such as the gender gap, contents, and formative processes in higher education, the strengthening of the competency of complex thinking, its use in the labor market, its use in the hegemonic patriarchal culture in Latin America, its ability to face professional challenges, and its effects on decision making and problem-solving.

The teaching of business process methods in business schools must include collaboration between academicians and practitioners for students to deepen their understanding of complexity to analyze situations to make proper decision-making. Entrepreneurs operate in uncertainty and risk, have limited resources, need to update their knowledge constantly, draw up plans but are ready to redirect them at any time, refine and improve their projects and products, and look for actors who can add more value. Therefore, students need to develop their complex thinking competency to think critically, systemically, scientifically, and innovatively to understand the complexity of the entrepreneurial environment, analyze the relevance of system elements, apply their inductive and deductive reasoning, and create appropriate and relevant solutions.

Beyond thinking that learning of this nature requires identifying reality and committing to learning to make rational decisions or decisions guided by impulses, we consider it more beneficial to teach students to grasp how they organize their ideas, to question rational decisions and actions, and become aware of the process of selecting meaningful data and rejecting those that are not meaningful. In this way, students can develop an

awareness of their vision of things and the world, which can help them make decisions about their projects and products that generate more value for their customers.

Conveying the message that understanding the operations that separate, unite, hierarchize, and centralize is crucial for a future entrepreneur because these determine the vision of things and the world. This understanding facilitates decisions based on the entrepreneur's vision of the world and what generates value for those purchasing their products or investing in their projects. In this realm, we propose incorporating complexity theory into discussing how entrepreneurs think and act to generate more value. Our methodology can be leveraged to assess complex thinking competencies in university business students at the beginning and end of their careers. In the future, we plan to extend this analysis to the behavior of real-life entrepreneurs.

Our findings suggest that an educational model focused on developing complex thinking and its four sub-competencies (critical, systemic, scientific, and innovative thinking) can enable entrepreneurs to integrate a sustainable development perspective, increase their social engagement and critical thinking, develop their imaginative intelligence and discursive and reflective skills, and improve their decision-making and problem-solving processes.

Acknowledgments

The authors appreciate the academic support from the Institute for the Future of Education, Tecnológico de Monterrey, through the "Challenge-Based Research Funding Program 2022" Project ID # I004 - IFE001 - C2-T3 – T.

The authors acknowledge the financial and technical support of Writing Lab, Institute for the Future of Education, Tecnológico de Monterrey, Mexico, in the production of this work.

References

- Amblee, N., Ertl, H., & Dhayanithy, D. (2022). A More Relevant MBA: The Role of Across-the-Curriculum Delivery of Intercompetency Coursework in Aligning the Required Curriculum With Required Managerial Competencies. *Journal of Management Education*, 47(2). <https://doi.org/10.1177/10525629221121700>.
- Association to Advance Collegiate Schools of Business (AACSB) (2018). Eligibility Procedures and Accreditation Standards for Business Accreditation. <https://www.aacsb.edu/-/media/documents/accreditation/2018-business-standards.pdf?rev=87acd91b6dcd4ca987f61fd63d6dac4b&hash=02A7DC298A392FF34BBA3FDBA27E1B01>.
- Baena-Rojas, J. J., Ramírez-Montoya, M.S., Mazo-Cuervo, D.M., & López-Caudana, E. O. (2022). Traits of

- Complex Thinking: A Bibliometric Review of a Disruptive Construct in Education. *Journal of Intelligence*, 10(37), 1-17. <https://doi.org/10.3390/jintelligence10030037>.
- Castillo-Martínez, I., Ramírez-Montoya, M., & Torres-Delgado, G. (2022). Reasoning for complexity competency instrument (e-Complexity): Content validation and expert judgment. *Education in the Knowledge Society* (In Press).
- Carreira, F.C., Gross, A.A., Gay, P.-E., & Silva, C.R. (2022). Techno Futurist, sustained inequalities and Eco-utopia: Speculative imaginaries of Business Education in 2050. *Futures*, 144. <https://doi.org/10.1016/j.futures.2022.103043>.
- Cruz-Sandoval, M., Vázquez-Parra, J.C., & Alonso-Galicia, P. (2022). Student Perception of Competencies and Skills for Social Entrepreneurship in Complex Environments: An Approach with Mexican University Students. *Social Sciences*, 11(314), 1-13. <https://doi.org/10.3390/socsci11070314>.
- García-González, A., Ramírez-Montoya, M. S., De León, G., & Aragón, S. (2020). El emprendimiento social como una competencia transversal: Construcción y validación de un instrumento de valoración en el contexto universitario. *REVESCO Revista de Estudios Cooperativos*, 136, e71862. <https://doi.org/10.5209/reve.71862>.
- Kurdoglu, R.S., Lerner, D., & Ates, N.Y. (2022). Unsticking the rationality stalemate: Motivated reasoning, reality, and irrationality. *Journal of Business Venturing Insights*, 18, e00336. <https://doi.org/10.1016/j.jbvi.2022.e00336>.
- Kuzina, E.V., Zhogova, I.G., & Nadezhkina, E.Y. (2022). Impact of teaching critical thinking skills on reading comprehension in higher business education. *Journal of Higher Education Theory and Practice*, 22 (15), 129-137. <https://doi.org/10.33423/jhetp.v22i15.5566>.
- Lerner, D.A., Hunt, R.A., & Dimov, D. (2018a). Action! Moving beyond the intendedly rational logic of entrepreneurship. *J. Bus. Ventur.* 33 (1), 52–69. <https://doi.org/10.1016/j.jbusvent.2017.10.002>.
- Lerner, D.A., Hunt, R.A., & Verheul, I. (2018b). Dueling banjos: harmony and discord between ADHD and entrepreneurship. *Acad. Manag. Perspect.* 32 (2), 266–286. <https://doi.org/10.5465/amp.2016.0178>.
- Mansoori, Y., & Lackéus, M. (2020). Comparing effectuation to discovery-driven planning, prescriptive entrepreneurship, business planning, lean startup, and design thinking. *Small Business Economics*, 54(3), 791–818.
- McDonald, D., Iscaro, V., & Posey, O.G. (2022). Active learning strategies in business education: using the law to build critical workforce skills. *Journal of International Education in Business*, 15(2), 406-424.
- Morin, E. (2001). *Introducción al pensamiento complejo*. Gedisa.
- Morin, E. (2020). *La mente bien ordenada: repensar la forma, reformar el pensamiento*. Siglo XXI Editores.
- Ramírez-Montoya, M. S., Castillo-Martínez, I.M., Sanabria-Zepeda, J.C., & Miranda, J. (2022). Complex Thinking in the Framework of Education 4.0 and Open Innovation—A Systematic Literature Review. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(4), 1-15. <https://doi.org/10.3390/joitmc8010004>.
- Rodríguez-Abitia, G., Ramírez-Montoya, M. S., Martínez-Pérez, S., & López- Caudana, E.O. (2022). Cultural differences in complexity reasoning in higher education. In Proceedings of the 10th International

Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM 2021). Salamanca University. Spain.

Sarasvathy, S.D (1998). *How do firms come to be? Towards a theory of the pre-firm*. Dissertation at Carnegie Mellon University. Pittsburgh, PA; UMI Microform.

Sarasvathy, S. D. (2001). Causation and effectuation: toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review*, 26, 243–263.

Vázquez-Parra, J.C., Castillo-Martínez, I.M., Ramírez-Montoya, M.S., & Millán, A. (2022). Development of the perception of achievement of complex thinking: A disciplinary approach in a Latin American student population. *Education Sciences*, 12(289), 1-12. <https://doi.org/10.3390/educsci12050289>.

Wiklund, J., Patzelt, H., & Dimov, D. (2016). Entrepreneurship and psychological disorders: How ADHD can be productively harnessed. *J. Bus. Vent. Ins.* 6, 14–20. <https://doi.org/10.1016/j.jbvi.2016.07.001>.

Wiklund, J., Yu, W., & Patzelt, H. (2018). Impulsivity and entrepreneurial action. *Acad. Manag. Perspect.* 32 (3), 379–403. <https://doi.org/10.5465/amp.2016.0177>.